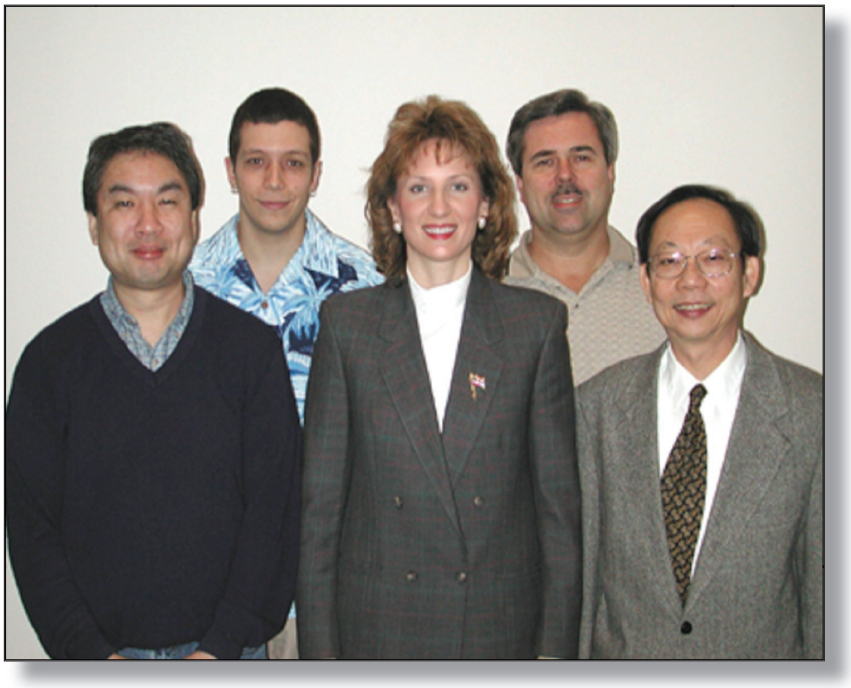
Air Force Research Laboratory|AFRL

Science and Technology for Tomorrow's Air and Space Force

Success Story

PROPULSION DIRECTORATE MAKES MAJOR ADVANCES IN CAPACITOR TECHNOLOGY



A Propulsion Directorate-led team recently produced the biggest improvement in decades in electrical and thermal properties of capacitor dielectrics. The Diamond-Like Carbon (DLC) Capacitor Team successfully optimized DLC plasma deposition parameters to produce capacitors with energy density and temperature capability three times the current state of the art. These improvements are crucial for airborne applications of directed energy weapons (DEW) because they offer considerable savings in system weight as well as superior performance.

Team members appearing from left to right in the photo are Mr. Kosai Hiroyuki, from K Systems; Mr. Jacob Diemer and Ms. Sandra-Fries Carr, both from the directorate's Power Division; Mr. Vic McNier, from the University of Dayton Research Institute; and Mr. Richard Wu, from K Systems.

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Accomplishment

In addition to tripling the energy density and temperature capabilities of current capacitors, the team recently demonstrated continuous and uniform deposition of DLC over a large area by manufacturing a 25 ft length of the DLC capacitor film. As a result, the Army and Navy committed funding to develop capacitor films for their own pulsed-power weapon applications.

Furthermore, an extensive collaborative effort exists with the Army and Navy to create an aggressive DLC Technology Transfer program with the goal of having a commercial product available by 2005. Scaling-up this technology will enable compact pulsed-power systems for pulsed high-power microwave applications. Both the aerospace and the DEW community identified this as a critical enabling technology.

Background

Capacitors are a critical component in nearly every military and commercial high-performance system. Military and commercial aircraft manufacturers, power supply manufacturers, the medical industry, and power utilities use high-temperature, high-energy-density capacitors.

The objective of the Diamond Thin Film Capacitor Development program was to fabricate DLC film capacitors for high-temperature and high-voltage applications that were superior to state-of-the-art devices. DLC has unique properties such as high dielectric strength, very high resistivity, high-temperature stability, high thermal conductivity, exceptional mechanical strength, and chemical inertness. These properties make it attractive for use in advanced power management and distribution systems where engineers expect temperatures above 300ºC (approximately 570ºF).

Propulsion
Technology Transfer

Additional information

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